AL.2.2007-15
C.2

DEVELOPMENT OF A MULTI-MODEL EXTRACTION UTILITY & ALBERTA METEOROLOGICAL DATA SET

Alberta Environment

DEVELOPMENT OF A MULTI-MODEL EXTRACTION UTILITY & ALBERTA METEOROLOGICAL DATA SET

Prepared by
RWDI AIR Inc.

for
Alberta Environment

June 2006

Pub. No: T/876
ISBN No. 0-7785-4643-8 (Printed)
ISBN No. 0-7785-4644-6 (On-Line)
Web Site: http://www3.gov.ab.ca/env/info/infocentre/publist.cfm

Although prepared with funding from Alberta Environment (AENV), the contents of this report/document do not necessarily reflect the views or policies of AENV, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Any comments, questions, or suggestions regarding the content of this document may be directed to:

Environmental Policy Branch
Alberta Environment
4th Floor, Oxbridge Place
9820 – 106th Street
Edmonton, Alberta T5K 2J6
Fax: (780) 422-4192

Additional copies of this document may be obtained by contacting:

Information Centre
Alberta Environment
Main Floor, Oxbridge Place
9820 – 106th Street
Edmonton, Alberta T5K 2J6
Phone: (780) 427-2700
Fax: (780) 422-4086
Email: env.infocent@gov.ab.ca

FOREWORD

Alberta Environment developed a meteorological dataset using data generated by Environment Canada. The dataset supports the air quality management in Alberta by providing meteorological data for the entire year of 2002. The dataset was generated using the NCAR / Penn State Fifth Generation Mesoscale Meteorological model (MM5). Queen's Printer will distribute the dataset.

Ahmed Idriss, Ph.D., P.Eng
Project Manager
Environmental Policy Branch

TABLE OF CONTENTS

FOREWORD i

TABLE OF CONTENTS ii

LIST OF FIGURES iii

1.0 BACKGROUND 1

2.0 TASK 1. PROVISION OF A PARED-DOWN SUBSET OF ENVIRONMENT CANADA'S 12 KM RESOLUTION MM5 OUTPUTS 2
  2.1 Environment Canada's 12 Km Resolution MM5 Outputs 2
  2.2 Data Extraction 3

3.0 TASK 2. DEVELOPMENT OF A SOFTWARE UTILITY TO PRODUCE METEOROLOGICAL INPUTS FOR COMMONLY USED AIR QUALITY MODELS 5

TECHNICAL APPENDICES 8

LIST OF FIGURES

Figure 1 Environment Canada's 36, 12, and 4 km MM5 Model Domains 2

Figure 2 Environment Canada Full Domain and Alberta Subset 3

Figure 3 Alberta MM5 Subset Domain and MM5 Terrain Heights (m). 4

Figure 4 Multi-Model Extraction Utility (MMEU) 6

1.0 BACKGROUND

There are a number of areas throughout the Province of Alberta where oil and gas exploration and other industrial activities result in the release of substances to the atmosphere. In many of these regions, meteorological observations are scarce. To improve air quality management, Alberta Environment would like to take advantage of a meteorological dataset generated by Environment Canada for other air quality modelling purposes. The dataset contains meteorological model outputs for the entire year of 2002 and was generated using the NCAR / Penn State Fifth Generation Mesoscale Meteorological model (MM5).

Alberta Environment retained RWDI AIR Inc. (RWDI) to perform two primary tasks:

- Task 1. Provide a pared-down subset of Environment Canada's 12 km resolution MM5 outputs covering Alberta only; and,
- Task 2. Develop a software utility that can be used with the Alberta MM5 subset provided under Task 1 to produce meteorological inputs for a variety of commonly used air quality models.

This report provides an overview of the methodology adopted to complete both Tasks. Attached are technical appendices that describe in greater detail the assumptions behind the Multi-Model Extraction Utility (MMEU) software product, as well as a series of screenshots and user notes. In this way, this document also serves as the User's Guide to MMEU. In addition to this report, the other project deliverables include:

- The pared-down subset of the 12 km resolution Environment Canada MM5 data covering Alberta only (provided on 20, fully labelled DVD-ROMs); and,
- The Multi-Model Extraction Utility (MMEU) as a compiled Windows executable.

2.0 TASK 1. PROVISION OF A PARED-DOWN SUBSET OF ENVIRONMENT CANADA'S 12 KM RESOLUTION MM5 OUTPUTS

This Task involved paring down the existing 463 Gb of outputs from Environment Canada's full model domain to cover Alberta only, and providing this subset of data to Alberta Environment. RWDI did not perform any form of evaluation or make comparisons of the Environment Canada MM5 results to observations under this contract.

2.1 Environment Canada's 12 Km Resolution MM5 Outputs

Environment Canada performed MM5 simulations as part of a set of nested model domains at horizontal resolutions of 36, 12, and 4 km as shown in Figure 1.

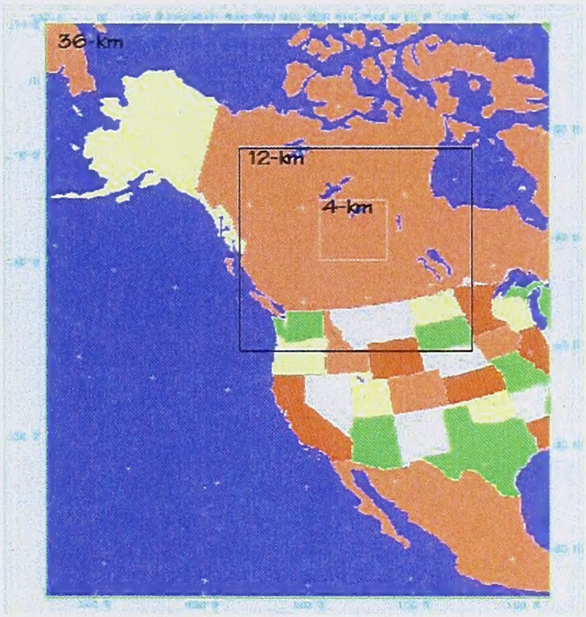


Figure 1 Environment Canada's 36, 12, and 4 km MM5 Model Domains

The Environment Canada 12 km resolution MM5 domain covers the entire prairie region as shown in Figure 2. The domain extends 199 grid cells or 2,388 km in the east-west, and 208 grid cells or 2,496 km in the north-south. A total of 30 vertical layers were modelled.

Environment Canada ran MM5 version 3.5 for every day of 2002, plus a couple of days on either end (i.e., last two days of 2001 and first two days of 2003). Runs were performed on a weekly basis with a 24-hour spin-up / overlap period. Individual outputs were generated for each and every day.

The file size for each day is approximately 1.268 Gb, equating to a total of 463 Gb for the entire year of output.

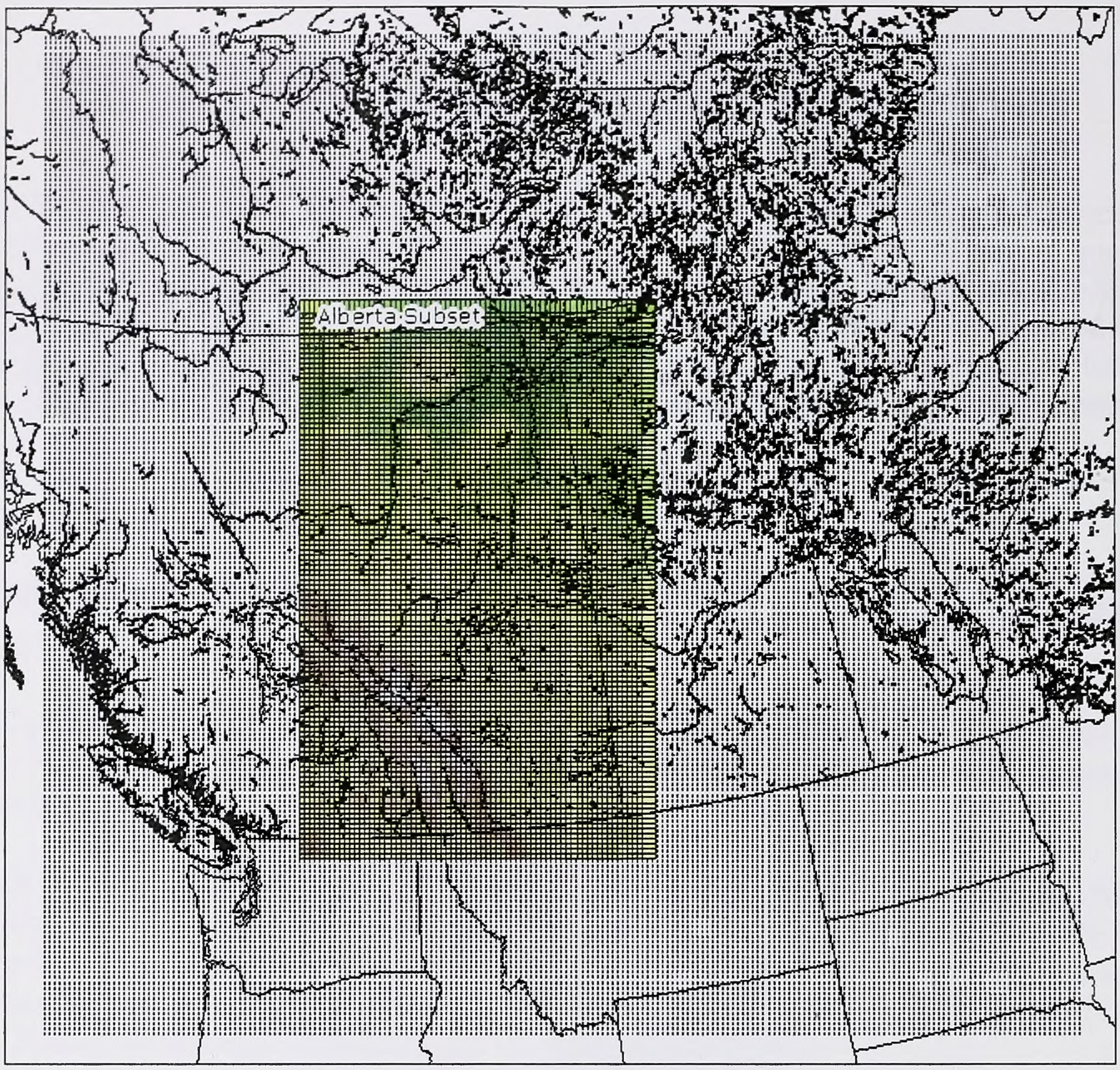


Figure 2 Environment Canada Full Domain and Alberta Subset

2.2 Data Extraction

The corresponding Latitude and Longitude coordinates of each 12 km grid cell were extracted from the raw MM5 outputs using RWDI's proprietary RAM-Dx data extractor. These were then plotted in ArcGIS to and projected using the Lambert Conic Conformal geographic projection used by Environment Canada in performing the MM5 simulations.

Based on this mesh of 12 km grid points, RWDI and Alberta Environment selected a suitable subdomain for extracting the 'Alberta only' subset. This subset in relation to the full 12 km model domain is shown in Figure 2 by the coloured grid cells (colours representing terrain height as extracted from MM5). Figure 3 depicts the Alberta subset only.

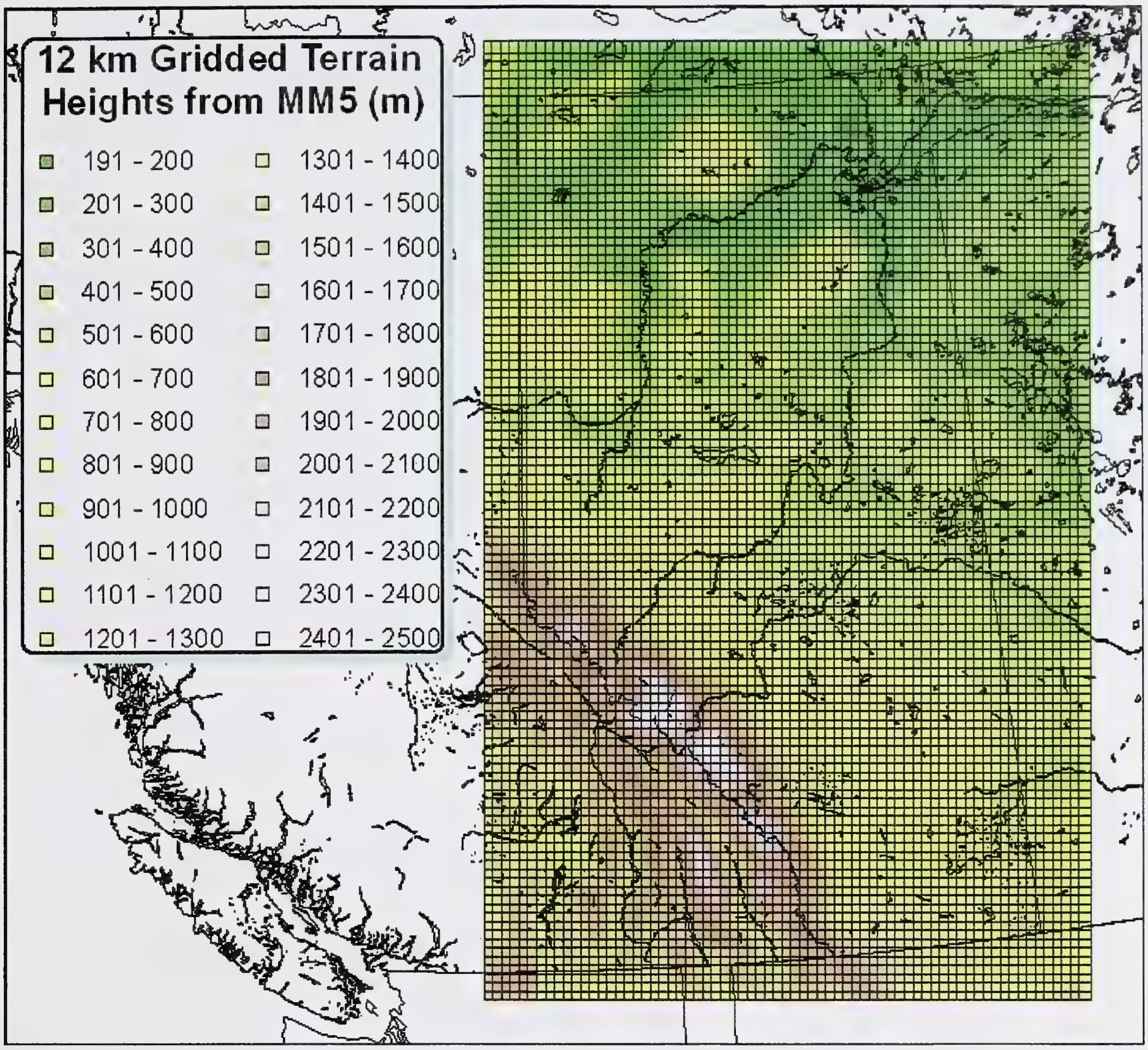


Figure 3 Alberta MM5 Subset Domain and MM5 Terrain Heights (m).

The extraction of MM5 PC Binary data files was performed using MMEU. Each of the 365 daily output files was processed to create a new, subset of daily MM5 PC binary output files (365 files) covering Alberta only. Each daily MM5 output for the Alberta subdomain is 225 Mb in size. Once completed, the 365 daily files were provided to Alberta Environment.

3.0 TASK 2. DEVELOPMENT OF A SOFTWARE UTILITY TO PRODUCE METEOROLOGICAL INPUTS FOR COMMONLY USED AIR QUALITY MODELS

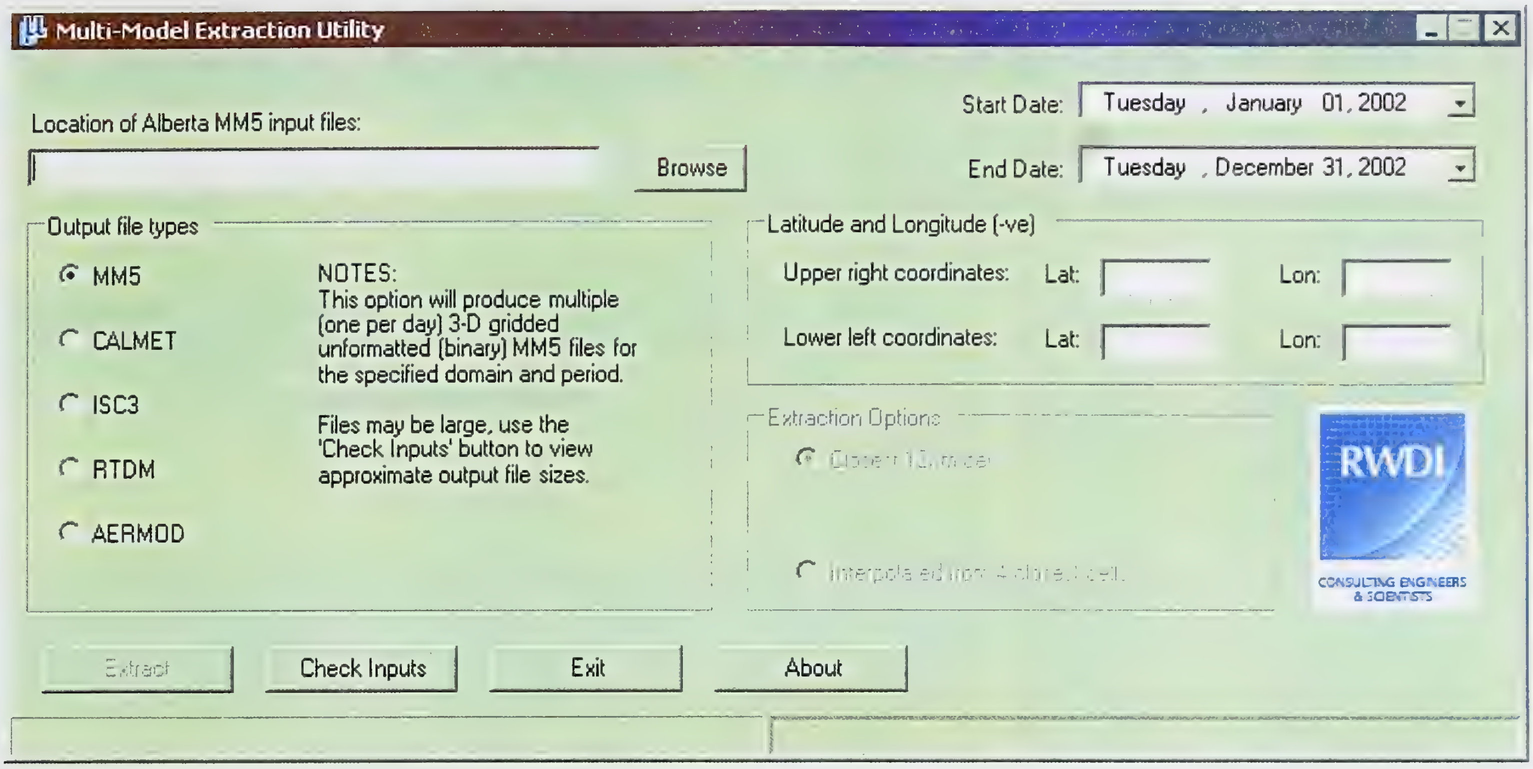
This task addresses Alberta Environment's requirements to develop and provide a user-friendly computer program that can be used to interpolate and extract the 12-km MM5 meteorological data to be used to drive air quality models.

RWDI developed the Multi-Model Extraction Utility software product as a Windows executable (provided to Alberta Environment on CD-ROM). The MMEU executable will be made freely available to the public (i.e., Users) who obtain a copy of the 12 km MM5 Alberta subset.

A screenshot of the MMEU interface is shown in Figure 4. Detailed descriptions of the different file formats and technical assumptions adopted in the extractions are provided in the technical appendices.

The supported formats that can be generated using MMEU include the following:

- **MM5** This option produces multiple (one per day) 3-D gridded unformatted (PC-Binary) MM5 files for the specified sub-domain and period.
- **CALMET** For the sub-domain and period specified, this option executes the CALMM5.exe (ver 2.4) executable and generates a run log file (.lst) a 2-D ASCII file (not used in CALMET), and a 3-D ASCII for input to CALMET. The 3-D file contains gridded precipitation data required to run with the wet deposition option in CALMET.
- **ISC** This option generates a single, pre-processed ASCII surface meteorological station file at a 10 m height for use with ISC3 or ISC-PRIME without wet or dry deposition parameters.
- **RTDM** This option generates a single, pre-processed ASCII surface meteorological station file at a 10 m height for use with RTDM.
- **AERMOD** This option generates two ASCII files: a SAMSON formatted surface station file at a 10- m height; and, a RAOBS upper air file, both of which can be used as input to the AERMET Stage 1 pre-processor to AERMOD. Note: These files could also be used to run other meteorological pre-processors (e.g., PC-RAMMET) if so desired.



Multi-Model Extraction Utility
Location of Alberta MM5 input files:
Browse
Output file types
● MM5
○ CALMET
○ ISC3
○ RTDM
○ AERMOD
Latitude and Longitude (-ve)
Upper right coordinates: Lat: Lon:
Lower left coordinates: Lat: Lon:
Extraction Options
● Closest 12 km cell
○ Interpolated from 4 closest cells
RWDI
CONSULTING ENGINEERS & SCIENTISTS
Extract
Check Inputs
Exit
About

Start Date: Tuesday , January 01, 2002

End Date: Tuesday , December 31, 2002

NOTES:
This option will produce multiple (one per day) 3-D gridded unformatted (binary) MM5 files for the specified domain and period.

Files may be large, use the 'Check Inputs' button to view approximate output file sizes.

Figure 4 **Multi-Model Extraction Utility (MMEU)**

For the MM5 and CALMET formats, the lower left and upper right coordinates of an extraction domain must be specified in Latitude / Longitude coordinates. MMEU will automatically compare the user-defined corners to a lookup table of the 12 km MM5 grid cells and extract the MM5 grid cells that cover the entire domain requested.

To facilitate the CALMET extraction option, MMEU calls and executes the freely downloadable CALMM5.exe (ver. 2.4) developed by Earth Tech Inc. windows executable “as-is”. The CALMM5.exe program file provided with MMEU.exe must be located in the same folder as MMEU.exe for the CALMET option to function properly (see Appendix D for details).

The way in which some PCs are configured can limit the allowable size of any one file (e.g., there is a 2.0 Gb file size limitation for hard drives that are formatted as FAT32). Because MM5 and CALMET-ready MM4.DAT ASCII files can be large, a function was included to allow the user to check the estimated size of the output files prior to extraction (“Check Inputs” button). The onus is on the user to change the input parameters (namely period and / or domain extents) and re-check the resultant file size prior to performing an extraction.

For the latter three formats, (i.e., ISC, RTDM, and AERMOD), the user must specify a single location at which they would like a representative meteorological dataset (e.g., centre of the facility, main stack, etc.). Locations must be specified in UTM coordinates based on a NAD83 Datum. Both UTM Zones 11 and 12 are supported.

Two extraction options are also available for the latter three file formats. MMEU will compare the user-entered coordinate to a lookup table of the 12 km MM5 grid cells and allow the user to choose to extract either:

1. The meteorological parameters that correspond to the closest 12 km grid cell to the location defined; or,

2. The distance weighted average of the meteorological parameters for the four closest grid cells.

TECHNICAL APPENDICES

The remainder of this document is comprised of the following technical appendices, which contain a wide range of technical specifics concerning the MMEU solution itself, user tips, etc.

Appendix A. End User License Agreement

Appendix B. General Usage Notes

Appendix C. MM5 Extraction Option

Appendix D. CALMET Extraction Option

Appendix E. ISC3 Extraction Option

Appendix F. RTDM Extraction Option

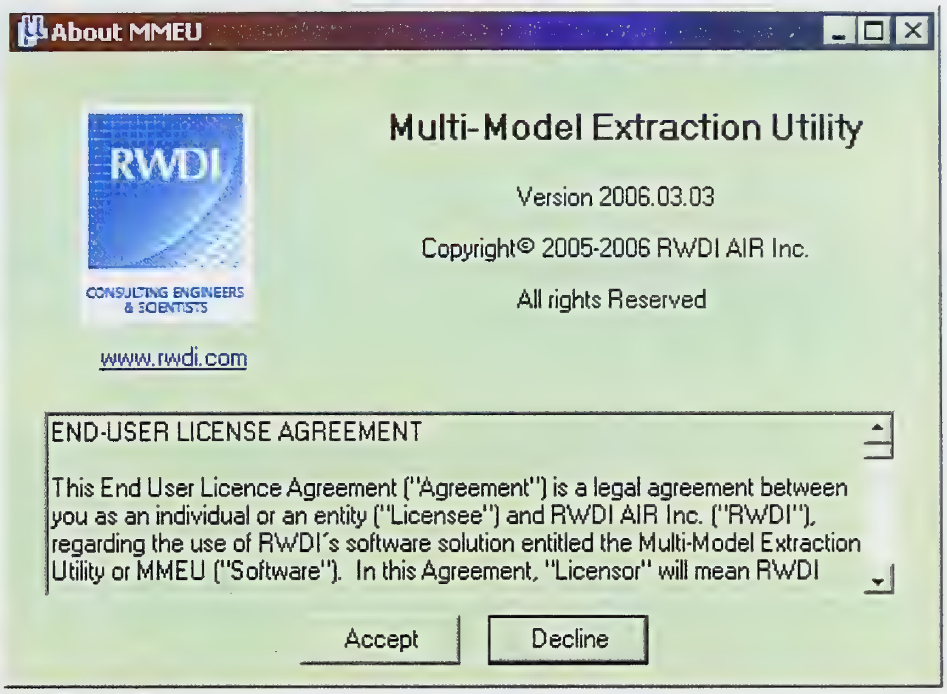
Appendix G. AERMOD Extraction Option

Appendix H. Alberta Subset 12 km Resolution MM5 Files Provided to Alberta Environment

APPENDIX A

APPENDIX A. END USE LICENSE AGREEMENT

An End User License Agreement is included in the Executable version of the MMEU Software. Any individual or entity that installs and / or runs the MMEU software solution is consenting to be bound by the End User License Agreement. A copy of the terms and conditions of the End User License Agreement is provided in this appendix for reference. The End User License Agreement must be 'Accepted' when launching the MMEU software. The End User License Agreement can also be viewed by clicking the 'About' button on the main application window as shown below.



Multi-Model Extraction Utility

Version 2006.03.03

Copyright© 2005-2006 RWDI AIR Inc.

All rights Reserved

END-USER LICENSE AGREEMENT

This End User Licence Agreement ("Agreement") is a legal agreement between you as an individual or an entity ("Licensee") and RWDI AIR Inc. ("RWDI"), regarding the use of RWDI's software solution entitled the Multi-Model Extraction Utility or MMEU ("Software"). In this Agreement, "Licensor" will mean RWDI

END-USER LICENSE AGREEMENT

This End User Licence Agreement ("Agreement") is a legal agreement between you as an individual or an entity ("Licensee") and RWDI AIR Inc. ("RWDI"), regarding the use of RWDI's software solution entitled the Multi-Model Extraction Utility or MMEU ("Software"). In this Agreement, "Licensor" will mean RWDI except if any third party software are included as part of the Software and no license is presented for acceptance the first time that third party software is invoked, then the use of those third party software will be governed by this Agreement, but the term "Licensor", with respect to such third party software, will mean the creator of that software and not RWDI. The creator of the third party software has neither reviewed nor tested the Software.

BEFORE YOU USE THE SOFTWARE, CAREFULLY READ THE TERMS AND CONDITIONS OF THIS AGREEMENT. BY INSTALLING AND / OR USING THE SOFTWARE YOU ARE CONSENTING TO BE BOUND AND ARE BECOMING A PARTY TO THIS AGREEMENT. IF YOU DO NOT AGREE TO ALL OF THE TERMS OF THIS AGREEMENT, DO NOT INSTALL THE SOFTWARE.

Licensor grants Licensee the license to use the compiled, executable code version of the Software, provided any copy must contain all of the original proprietary notices. This license does not entitle Licensee to receive from Licensor technical support, telephone assistance, assistance with compatibility or enhancements or updates to the Software. Licensee will be responsible for determining the appropriate use to be made of the Software. Licensee will be responsible for verifying all results produced by the Software.

Licensor owns and retains all right, title and interest in and to the Software, including patents, trademarks, copyrights, trade secrets and other intellectual property rights embodied or contained therein. Except as otherwise expressly permitted in this Agreement, Licensee may not modify or create any derivative works of the Software, decompile, disassemble, reverse engineer, or otherwise attempt to derive the source code for the Software, redistribute, encumber, sell, rent, lease, sublicense or otherwise transfer rights to the Software, remove or alter any trademark, logo, copyright or other proprietary notices, legends, symbols or labels in the Software or publish any results of benchmark tests run on the Software to a third party without Licensor's prior written consent.

Licensor hereby grants Alberta Environment license to copy and freely distribute the Software in support of air quality modelling applications being performed in the Province of Alberta, Canada.

THE SOFTWARE IS PROVIDED 'AS IS' AND WITHOUT WARRANTY OR CONDITION OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OF ACCURACY OR COMPLETENESS OF RESPONSES, OF RESULTS OR RELIABILITY, OF REASONABLE CARE OR WORKMANLIKE EFFORT. LICENSEE WILL BE SOLELY RESPONSIBLE FOR THE SELECTION, USE, EFFICIENCY AND SUITABILITY OF THE SOFTWARE AND ANY HARDWARE ON WHICH IT WILL RUN AND LICENSOR WILL HAVE NO LIABILITY THEREFORE. LICENSOR SPECIFICALLY DOES NOT WARRANT THAT THE SOFTWARE WILL MEET ALL OF THE LICENSEE REQUIREMENTS, OR WILL OPERATE IN ALL THE COMBINATIONS WHICH MAY BE SELECTED FOR USE BY THE LICENSEE, OR THAT THE OPERATION OF THE SOFTWARE WILL BE ERROR FREE OR UNINTERRUPTED, OR THAT ANY OR ALL SOFTWARE DEFECTS WILL BE CORRECTED.

Except to the extent applicable by law, if any, provides otherwise, this Agreement will be governed by the laws of Ontario. This Agreement will be binding on and will endure to the benefit of the parties, their successors and permitted assigns.

The provisions of this Agreement, which require or contemplate performance after the expiration or termination of this Agreement will be enforceable notwithstanding said expiration or termination. Without prejudice to any other rights, Licensor may terminate this Agreement if Licensee breaches any of its terms and conditions. On termination, Licensee will destroy all copies of the Software.

This Agreement constitutes the entire agreement between the parties concerning the subject matter hereof.

APPENDIX B

APPENDIX B. GENERAL USAGE NOTES

- Both Alberta Environment and RWDI are interested in receiving information and feedback on: the usefulness of the application, feature enhancement requests, bugs, etc. Please send suggestions, feedback and comments to: MMEU.Feedback@rwdi.com (a link is available from the About dialogue).

- MMEU was designed to run on the Windows 2000 (or higher) operating system with version 1.1 (or higher) of the .NET Framework (http://msdn.microsoft.com/netframework/downloads/framework1_1/). MMEU can also run from most network drives (successful execution depends on the security configuration of the network).

- Any Alberta subset MM5 files to be accessed must first be located on a single drive prior to extraction (i.e., MMEU does not currently support swapping DVDs in and out during an extraction). To process an entire year of data, all files from the entire 20 DVD set must first be copied to single, local or network drive.

- MMEU does not currently support the performance of multiple extractions in a single execution (i.e., batch runs not supported).

- MMEU has been designed to work explicitly with the Alberta Subset 12 km MM5 files generated by RWDI under Task 1 of this project only. MMEU will not currently run with other MM5 files.

- No context sensitive help has been provided within the GUI. All of the information needed to execute a run is readily available in this document and / or on-screen in the GUI itself.

- MMEU does not support concurrent versions operating simultaneously.

- All date specifications made by the user are in local time (as opposed to GMT) and are for full days only (i.e., no partial days).

- Because of differences in GMT versus local time and hour indexing differences for different file formats, it may be necessary to have available Alberta Subset data files for more days than those being extracted (i.e., one buffer day before or after the extraction period may be required).

- The way in which some PCs are configured can limit the allowable size of any one file (e.g., there is a 2.0 Gb file size limitation for hard drives that are formatted as FAT32). The ‘Check Inputs’ button can be used to determine the estimated size of the output files prior to extraction. The onus is on the user to change the input parameters (namely period and / or domain extents) and re-check the resultant file size prior to performing an extraction. For the CALMET option, it is assumed that all 30 vertical levels will be extracted (see Appendix D for more details).

- The extents of the Alberta subset and hence extents for the extraction of outputs must fall within the following constraints:

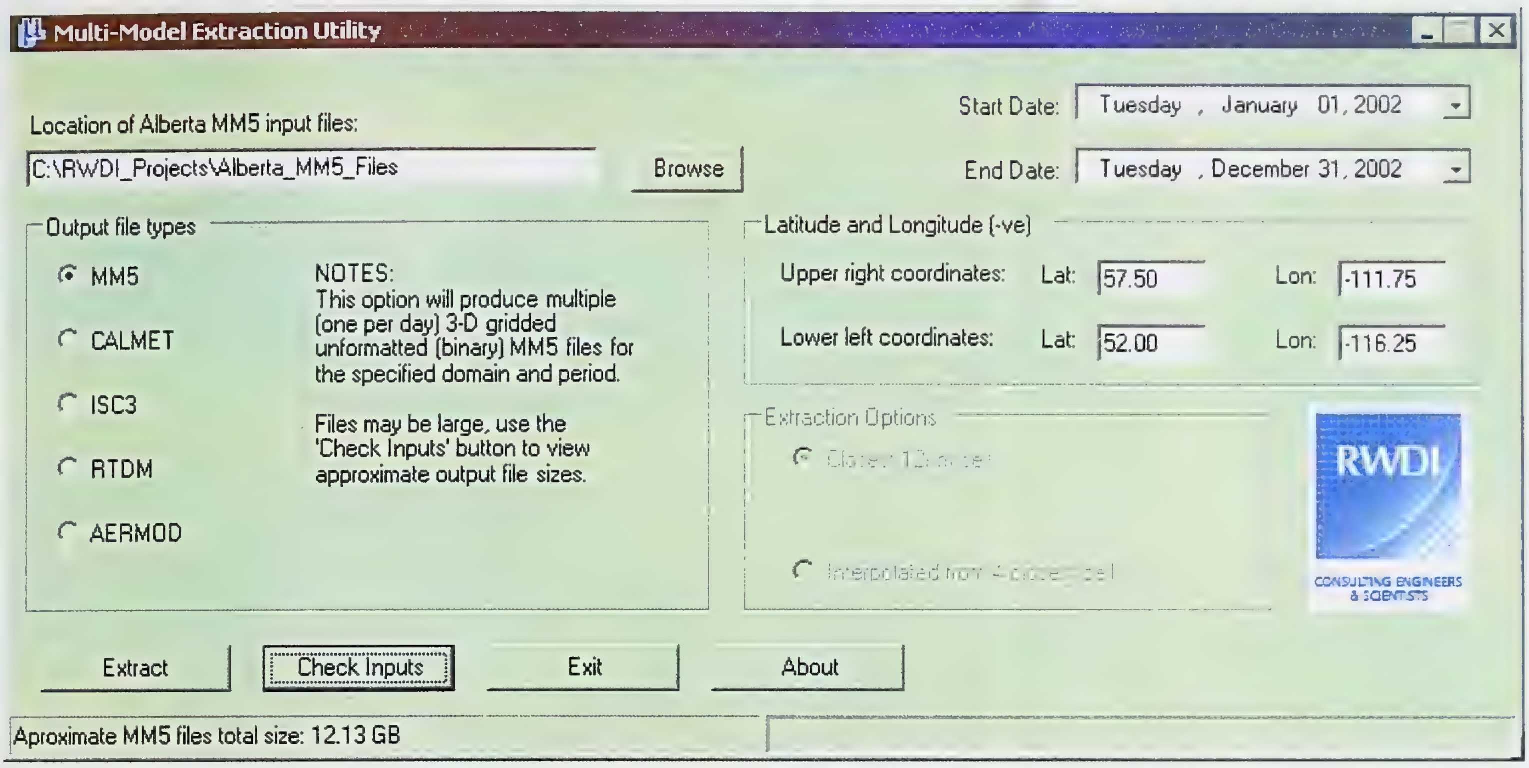
Corners	**MM5 Indices [1]**		**Geographic**		**UTM Zone 11 NAD83**		**UTM Zone 12 NAD83**	
	I	**J**	**Longitude (degrees)**	**Latitude (degrees)**	**Easting (m)**	**Northing (m)**	**Easting (m)**	**Northing (m)**
Lower Left	0	0	-120.7462	48.7207	224488	5403185	-216381	5442409
Lower Right	0	68	-109.3251	48.1543	1070615	5362003	624567	5334808
Upper Left	108	0	-120.6712	60.6082	299071	6724756	-28194	6758122
Upper Right	108	68	-105.9450	59.9021	1116520	6692214	782607	6651310

Notes:

[1] Alberta Subset 12 km MM5 grid cell indices (0,0 of the Alberta Subset corresponds to 36,52 of the Environment Canada full 12 km MM5 domain).

APPENDIX C

APPENDIX C. MM5 EXTRACTION OPTION


Multi-Model Extraction Utility
Browse
Extract
Check Inputs
Exit
About
RWDI
CONSULTING ENGINEERS & SCIENTISTS

Location of Alberta MM5 input files: C:\RWDI_Projects\Alberta_MM5_Files

Start Date: Tuesday , January 01, 2002

End Date: Tuesday , December 31, 2002

Output file types

● MM5

○ CALMET

○ ISC3

○ RTDM

○ AERMOD

NOTES:
This option will produce multiple (one per day) 3-D gridded unformatted (binary) MM5 files for the specified domain and period.

Files may be large, use the 'Check Inputs' button to view approximate output file sizes.

Latitude and Longitude (-ve)

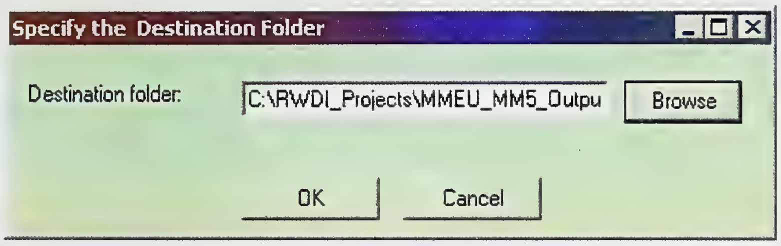
Upper right coordinates:	Lat:	57.50	Lon:	-111.75
Lower left coordinates:	Lat:	52.00	Lon:	-116.25

Extraction Options

● Closest 1 Grid cell

○ Interpolated from 4 closest cell

Aproximate MM5 files total size: 12.13 GB



Destination folder: C:\RWDI_Projects\MMEU_MM5_Outpu

Usage Notes

- This option produces multiple (one per day) 3-D gridded unformatted (PC-Binary) MM5 version 3.5 files for the specified sub-domain and period.

- Because the file naming convention adopted for the output files retains the same structure as the inputs, the destination folder must be different than the input folder. For this same reason, an output filename is not required, only the destination folder.

- The domain must be specified in decimal Latitude / Longitude coordinates (longitude as a negative) and fall within the constraints defined by the Alberta Subset and specified in Appendix A.

- MMEU will automatically output all grid cells that are fully or partially contained by the user-specified domain.

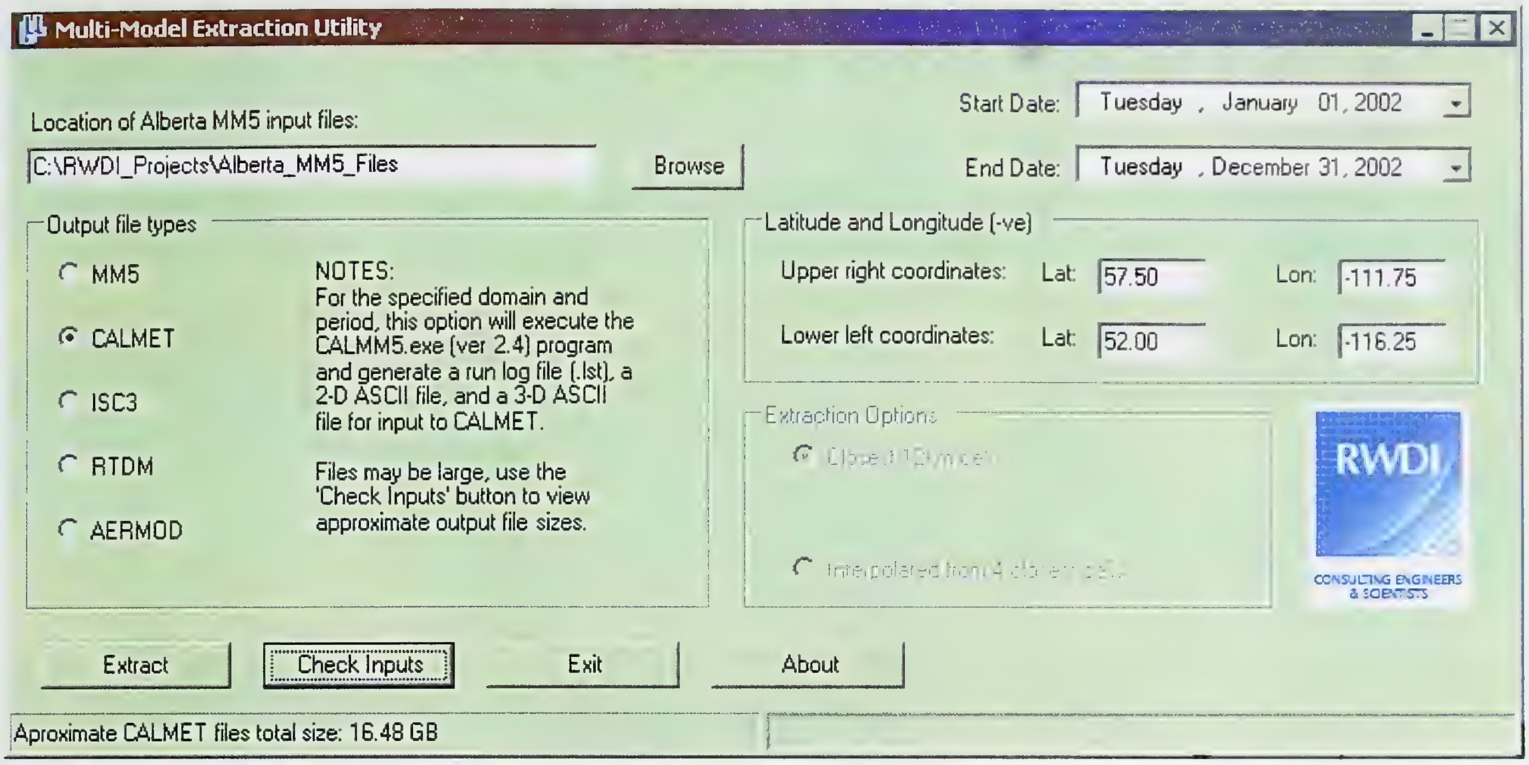
- The way in which some PCs are configured can limit the allowable size of any one file (e.g., there is a 2.0 Gb file size limitation for hard drives that are formatted as FAT32). The 'Check Inputs' button can be used to determine the estimated size of the output files prior to extraction. The onus is on the user to change the input parameters (namely period and / or domain extents) and re-check the resultant file size prior to performing an extraction.

- When performing an extraction, MMEU treats the original Environment Canada full domain as the 'Mother Domain' in reference to the I and J grid cell indexing of the resultant (i.e., child) output files.

- For more information on the MM5 file format, refer to http://www.mmm.ucar.edu/mm5.

APPENDIX D

APPENDIX D. CALMET EXTRACTION OPTION


Multi-Model Extraction Utility
Browse
Extract
Check Inputs
Exit
About
RWDI
CONSULTING ENGINEERS & SCIENTISTS

Location of Alberta MM5 input files: C:\RWDI_Projects\Alberta_MM5_Files

Start Date: Tuesday , January 01, 2002

End Date: Tuesday , December 31, 2002

Output file types

○ MM5
● CALMET
○ ISC3
○ RTDM
○ AERMOD

NOTES:
For the specified domain and period, this option will execute the CALMM5.exe (ver 2.4) program and generate a run log file (.lst), a 2-D ASCII file, and a 3-D ASCII file for input to CALMET.

Files may be large, use the 'Check Inputs' button to view approximate output file sizes.

Latitude and Longitude (-ve)

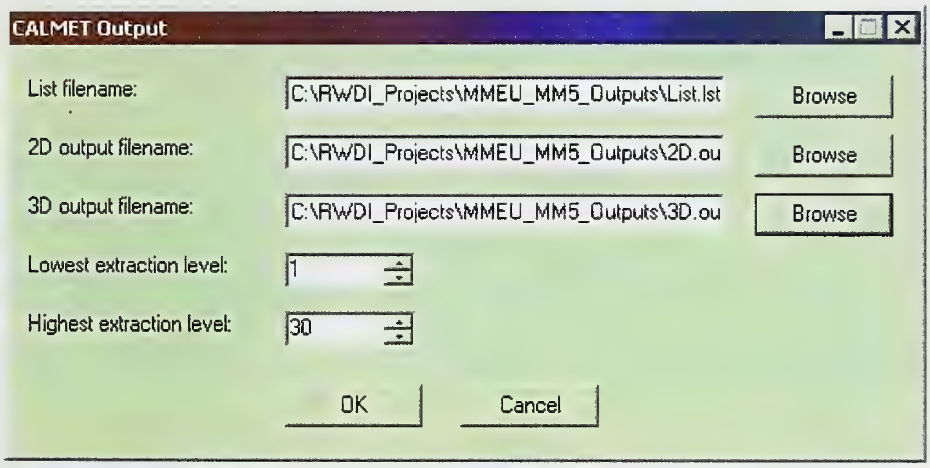
Upper right coordinates: Lat: 57.50 Lon: -111.75

Lower left coordinates: Lat: 52.00 Lon: -116.25

Extraction Options

● Closest (1) grid cell
○ Interpolated from 4 closest cells

Aproximate CALMET files total size: 16.48 GB



List filename: C:\RWDI_Projects\MMEU_MM5_Outputs\List.lst

2D output filename: C:\RWDI_Projects\MMEU_MM5_Outputs\2D.ou

3D output filename: C:\RWDI_Projects\MMEU_MM5_Outputs\3D.ou

Lowest extraction level: 1

Highest extraction level: 30

Usage Notes

- For the sub-domain and period specified, this option executes the CALMM5.exe (version 2.4) executable and generates a run log file (.lst), a 2-D ASCII file (not used in CALMET), and a 3-D ASCII file for input to CALMET version 5.5313 Level 051216.

- The 3-D format file contains gridded precipitation data required to run with the wet deposition option in CALMET.

- The domain must be specified in decimal Latitude / Longitude coordinates (longitude as a negative) and fall within the constraints defined by the Alberta Subset and specified in Appendix A.

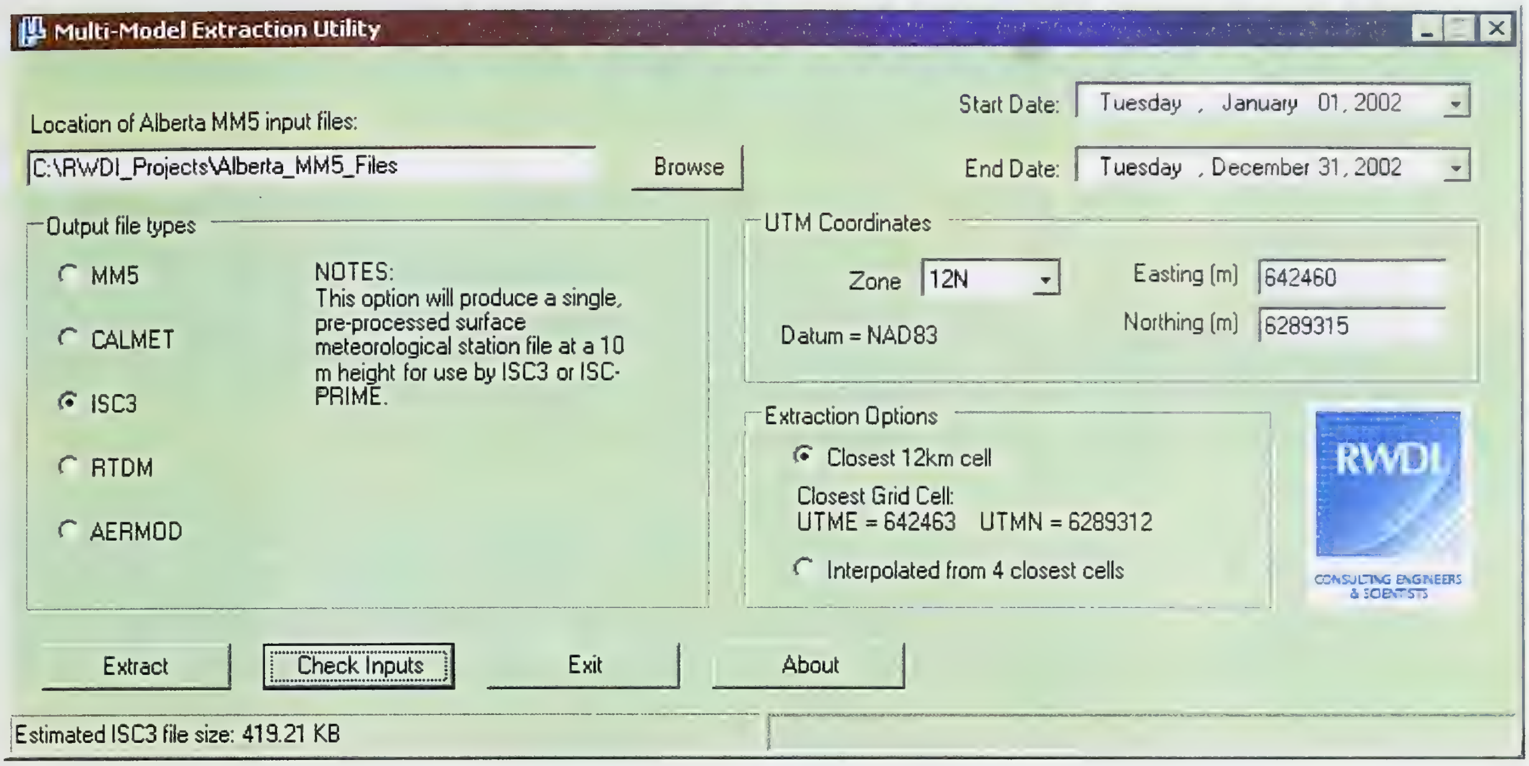
- MMEU will output all grid cells that are fully or partially contained by the user-specified domain.

- As part of the extraction process, the user must also provide the output file names and paths for all three output files to be generated, as well as the vertical levels to be extracted. The default spans all 30 vertical levels in the Alberta Subset MM5 files (i.e., Lowest = 1, Highest = 30).

- To facilitate this part of the extraction, MMEU calls and executes the freely downloadable CALMM5.exe (version 2.4) windows executable "as-is" and without warranty or condition of any kind as indicated in the End User License Agreement. The CALMM5.exe file must be located in the same windows folder as the MMEU.exe program for the CALMET option to function properly.

APPENDIX E

APPENDIX E. ISC3 EXTRACTION OPTION


Multi-Model Extraction Utility
Browse
Extract
Check Inputs
Exit
About
RWDI
CONSULTING ENGINEERS & SCIENTISTS

Location of Alberta MM5 input files: C:\RWDI_Projects\Alberta_MM5_Files

Start Date: Tuesday , January 01, 2002

End Date: Tuesday , December 31, 2002

Output file types

○ MM5
○ CALMET
● ISC3
○ RTDM
○ AERMOD

NOTES:
This option will produce a single, pre-processed surface meteorological station file at a 10 m height for use by ISC3 or ISC-PRIME.

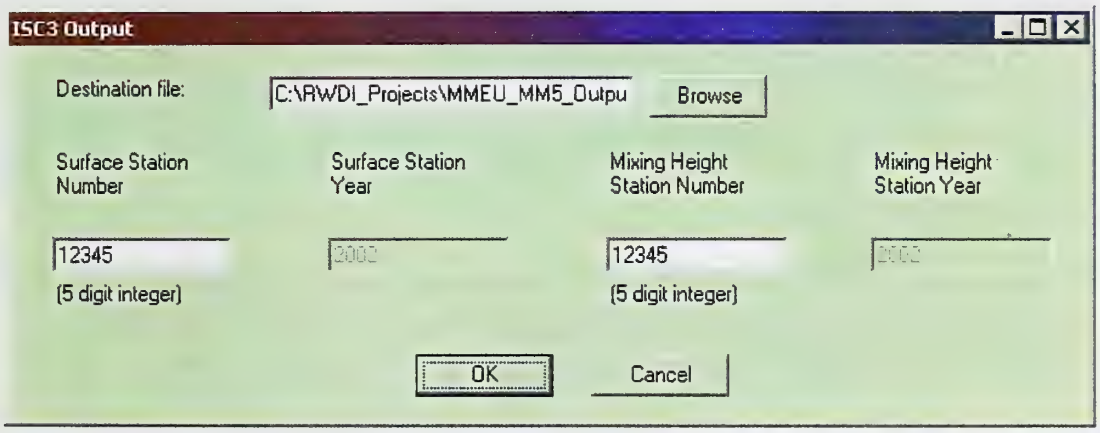
UTM Coordinates

Zone 12N
Datum = NAD83
Easting (m) 642460
Northing (m) 6289315

Extraction Options

● Closest 12km cell
Closest Grid Cell:
UTME = 642463 UTMN = 6289312
○ Interpolated from 4 closest cells

Estimated ISC3 file size: 419.21 KB



Destination file: C:\RWDI_Projects\MMEU_MM5_Outpu

Surface Station Number	Surface Station Year	Mixing Height Station Number	Mixing Height Station Year
12345 (5 digit integer)	2002	12345 (5 digit integer)	2002

Usage Notes

- This option generates a single, pre-processed ASCII surface meteorological station file at a 10 m height for use with ISC3 or ISC-PRIME without wet or dry deposition parameters.

- The user must specify the desired extraction location in units of metres. The location can be specified in either UTM Zone 11 or 12, based on the NAD83 datum.

- Using a series of look-up tables internal to the software, MMEU will compare the user-defined location to the 12 km MM5 grid cells and allow the user to choose to extract an input file for either:

  1. The meteorological parameters that correspond to the closest 12 km grid cell to the specified location; or,

2. The distance weighted average of the meteorological parameters for the four closest grid cells.

If option 1 is selected, the coordinates of the closest MM5 grid cell will be shown once the 'Check Inputs' button has been pressed (in the UTM Zone specified by the user).

- All meteorological fields are taken directly from the MM5 outputs, with the exception of stability class.

- Stability classes were derived from the solar radiation and temperature gradient modelled by MM5 based on the SRDT method as described further below (Meteorological Monitoring Guidance for Regulatory Modeling Applications, USEPA, February 2000, EPA-454/R-99-005).

- As specified in the PCrammet manual, standard EPA practice in regulatory dispersion modeling is to restrict temporal changes in stability class to no more than one per hour. The same stability class smoothing procedure adopted in PCrammet is implemented in MMEU.

- Hourly values of mixing height were taken directly from the MM5 outputs (MM5 Variable PBL_HGT) and not estimated using the Holzworth method.

- All resultant mixing heights predicted by MM5 to be less than 50 m are rounded up by MMEU to equal 50 m as directed by Alberta Environment.

- All resultant wind speeds predicted by MM5 to be less than 1 m/s are rounded up by MMEU to equal 1 m/s as per standard EPA practices described in Section 9.3.4 of Appendix W of the US EPA's guidelines on the use air quality models for regulatory applications (US EPA Appendix W to 40 CFR Part 51 – Guideline on Air Quality Models, April 15, 1003).

- As part of the extraction process, the user must also provide an output file name and path, as well as representative 5-digit integer values for both the 'Surface Station Number' and 'Mixing Height Station Number'.

Description of the SRDT Method

Source: Meteorological Monitoring Guidance for Regulatory Modeling Applications, USEPA, February 2000, EPA-454/R-99-005

6.4.2 Solar radiation/delta-T (SRDT) method

The solar radiation/delta-T (SRDT) method retains the basic structure and rationale of Turner's method while obviating the need for observations of cloud cover and ceiling. The method, outlined in Table 6-7, uses the surface layer wind speed (measured at or near 10 m) in combination with measurements of total solar radiation during the day and a low-level vertical temperature difference (ΔT) at night (see Section 3.1.2.1 for guidance on probe placement for measurement of the surface layer ΔT). The method is based on Bowen et al. [37] with modifications as necessary to retain as much as possible of the structure of Turner's method.

Table 6-7

Key to Solar Radiation Delta-T (SRDT) Method for Estimating Pasquill-Gifford (P-G) Stability Categories

DAYTIME

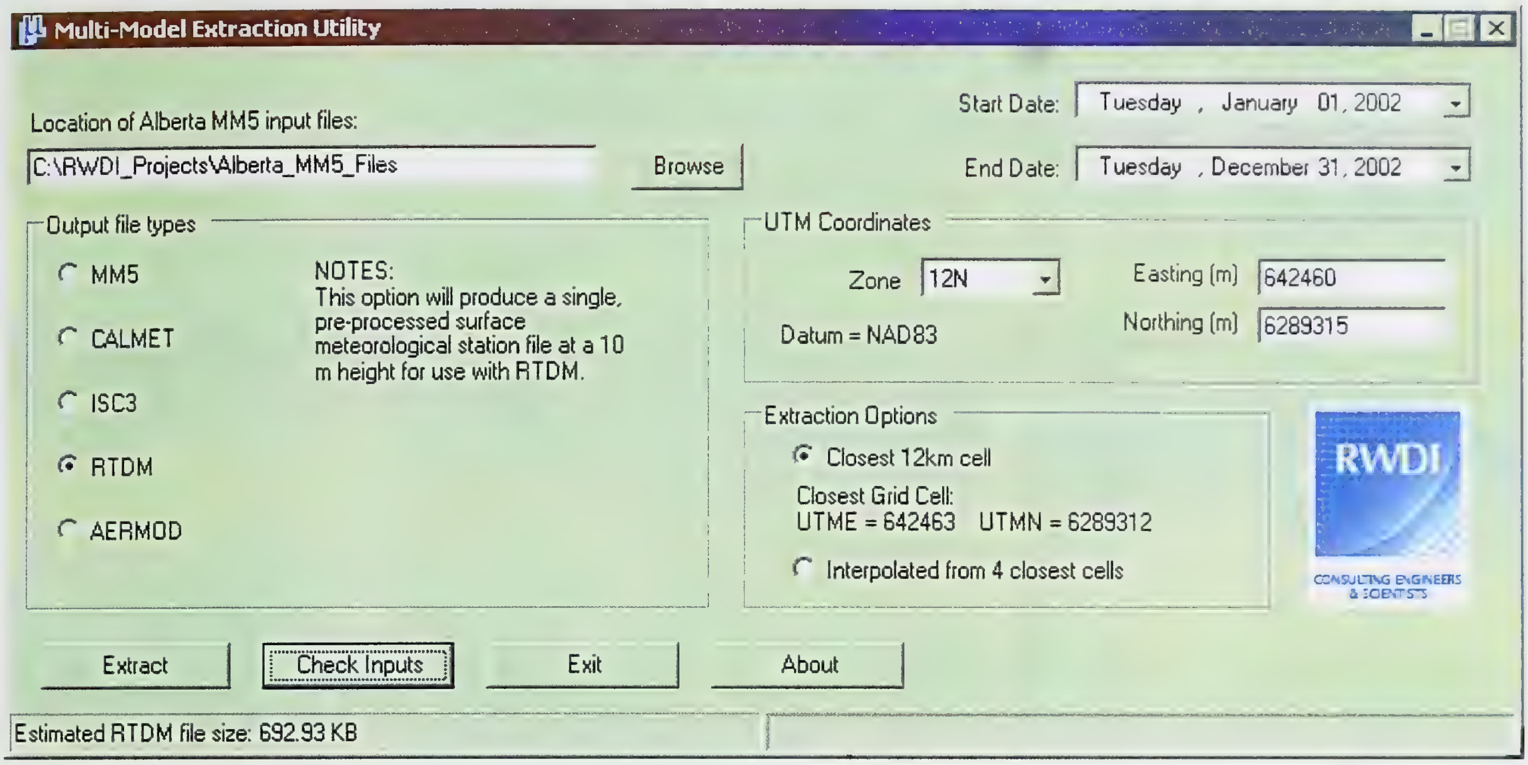
	Solar Radiation (W/m^2)			
Wind Speed (m/s)	≥ 925	925 - 675	675 - 175	< 175
< 2	A	A	B	D
2 - 3	A	B	C	D
3 - 5	B	B	C	D
5 - 6	C	C	D	D
≥ 6	C	D	D	D

NIGHTTIME

	Vertical Temperature Gradient	
Wind Speed (m/s)	< 0	≥ 0
< 2.0	E	F
2.0 - 2.5	D	E
≥ 2.5	D	D

APPENDIX F

APPENDIX F. RTDM EXTRACTION OPTION


Multi-Model Extraction Utility
Browse
Extract
Check Inputs
Exit
About
RWDI
CONSULTING ENGINEERS & SCIENTISTS

Location of Alberta MM5 input files: C:\RWDI_Projects\Alberta_MM5_Files

Start Date: Tuesday , January 01, 2002

End Date: Tuesday , December 31, 2002

Output file types

○ MM5

○ CALMET

○ ISC3

● RTDM

○ AERMOD

NOTES:
This option will produce a single, pre-processed surface meteorological station file at a 10 m height for use with RTDM.

UTM Coordinates

Zone 12N

Datum = NAD83

Easting (m) 642460

Northing (m) 6289315

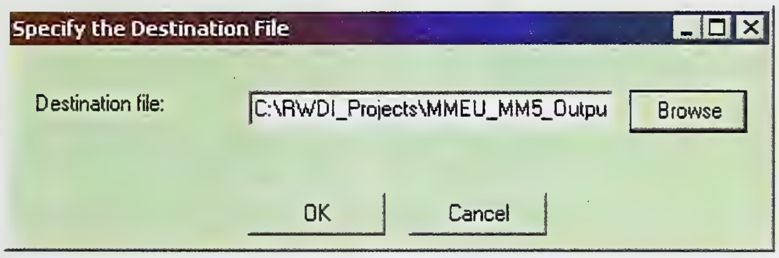
Extraction Options

● Closest 12km cell

Closest Grid Cell:
UTME = 642463 UTMN = 6289312

○ Interpolated from 4 closest cells

Estimated RTDM file size: 692.93 KB



Destination file: C:\RWDI_Projects\MMEU_MM5_Outpu

Usage Notes

- This option generates a single, pre-processed ASCII surface meteorological station file at a 10 m height for use with RTDM.

- The user must specify the desired extraction location in units of metres. The location can be specified in either UTM Zone 11 or 12, based on the NAD83 datum.

- Using a series of look-up tables internal to the software, MMEU will compare the user-defined location to the 12 km MM5 grid cells and allow the user to choose to extract an input file for either:

  1. The meteorological parameters that correspond to the closest 12 km grid cell to the specified location; or,

  2. The distance weighted average of the meteorological parameters for the four closest grid cells.

  If option 1 is selected, the coordinates of the closest MM5 grid cell will be shown once the 'Check Inputs' button has been pressed (in the UTM Zone specified by the user).

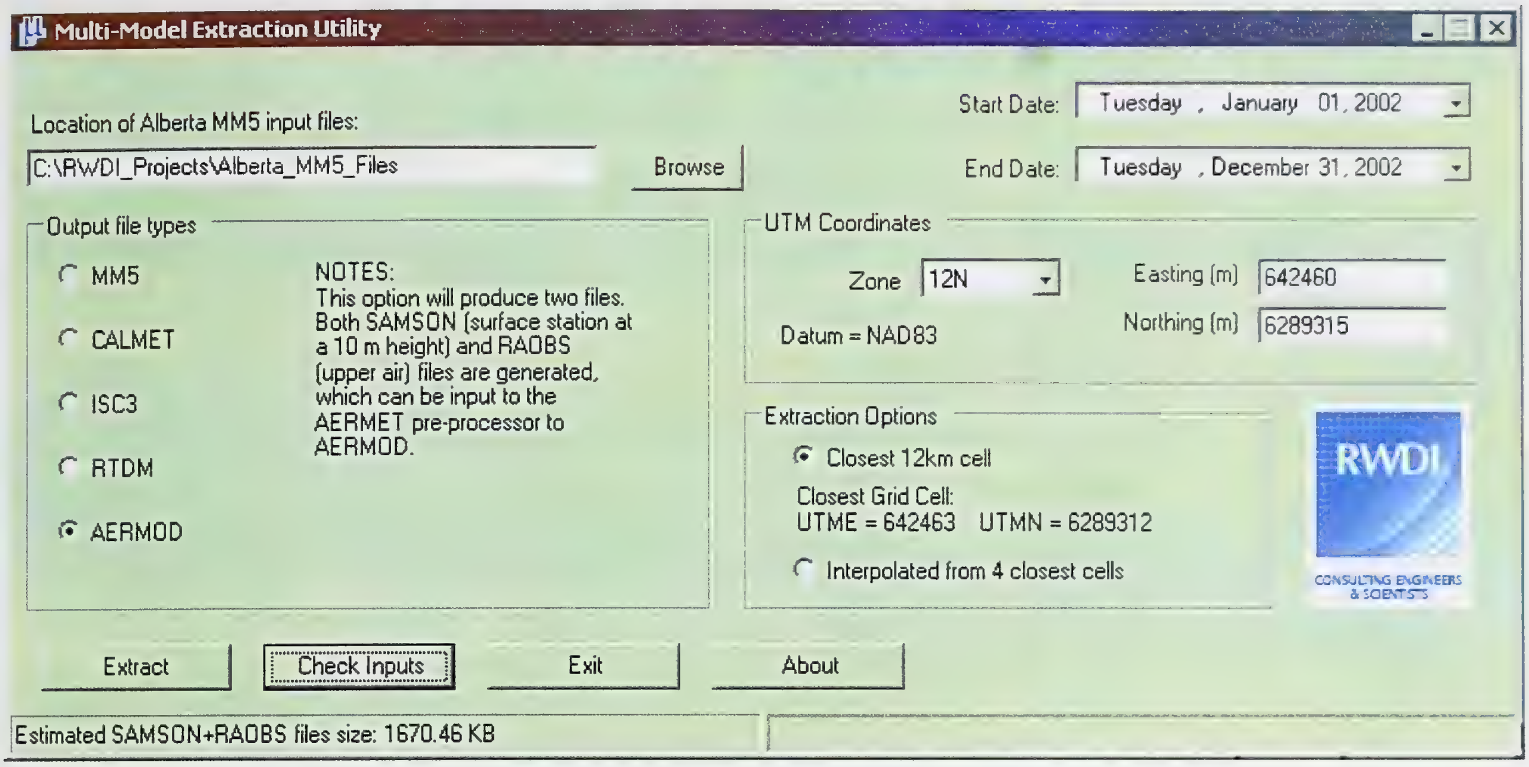
- All resultant mixing heights predicted by MM5 to be less than 50 m are rounded up by MMEU to equal 50 m as directed by Alberta Environment.

- All resultant wind speeds predicted by MM5 to be less than 1 m/s are rounded up by MMEU to equal 1 m/s as per standard EPA practices described in Section 9.3.4 of Appendix W of the US EPA's guidelines on the use air quality models for regulatory applications (US EPA Appendix W to 40 CFR Part 51 – Guideline on Air Quality Models, April 15, 1003).

- As part of the extraction process, the user must also provide an output file name and path.

APPENDIX G

APPENDIX G. AERMOD EXTRACTION OPTION


Multi-Model Extraction Utility
Browse
Extract
Check Inputs
Exit
About
RWDI
CONSULTING ENGINEERS & SCIENTISTS

Location of Alberta MM5 input files: C:\RWDI_Projects\Alberta_MM5_Files

Start Date: Tuesday , January 01, 2002

End Date: Tuesday , December 31, 2002

Output file types

○ MM5

○ CALMET

○ ISC3

○ RTDM

● AERMOD

NOTES:
This option will produce two files. Both SAMSON (surface station at a 10 m height) and RAOBS (upper air) files are generated, which can be input to the AERMET pre-processor to AERMOD.

UTM Coordinates

Zone: 12N

Datum = NAD83

Easting (m): 642460

Northing (m): 6289315

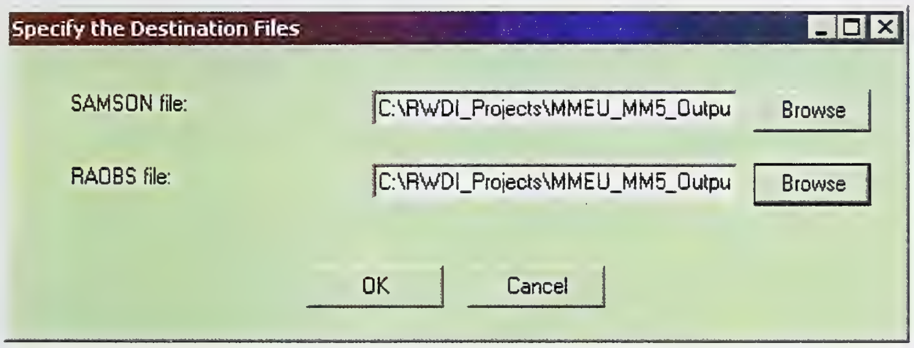
Extraction Options

● Closest 12km cell

Closest Grid Cell:
UTME = 642463 UTMN = 6289312

○ Interpolated from 4 closest cells

Estimated SAMSON+RAOBS files size: 1670.46 KB



SAMSON file: C:\RWDI_Projects\MMEU_MM5_Outpu

RAOBS file: C:\RWDI_Projects\MMEU_MM5_Outpu

Usage Notes

- This option generates two ASCII files: a SAMSON formatted surface station file at a 10- m height; and, a RAOBS (NCDC TD6201) upper air file, both of which can be used as input to the AERMET Stage 1 pre-processor to AERMOD.

- All meteorological fields required to run the pre-processor AERMET were derived from the MM5 outputs with the exception of cloud cover and ceiling height.

- An algorithm derived from code contained in the US EPA's Meteorology-Chemistry Interface Processor (MCIP) program was used to convert the condensed water in each vertical layer into a cloud fraction and extrapolate the ceiling height.

- The user must specify the desired extraction location in units of metres. The location can be specified in either UTM Zone 11 or 12, based on the NAD83 datum.

- Using a series of look-up tables internal to the software, MMEU will compare the user-defined location to the 12 km MM5 grid cells and allow the user to choose to extract an input file for either:

  1. The meteorological parameters that correspond to the closest 12 km grid cell to the specified location; or,

  2. The distance weighted average of the meteorological parameters for the four closest grid cells.

  If option 1 is selected, the coordinates of the closest MM5 grid cell will be shown once the 'Check Inputs' button has been pressed (in the UTM Zone specified by the user).

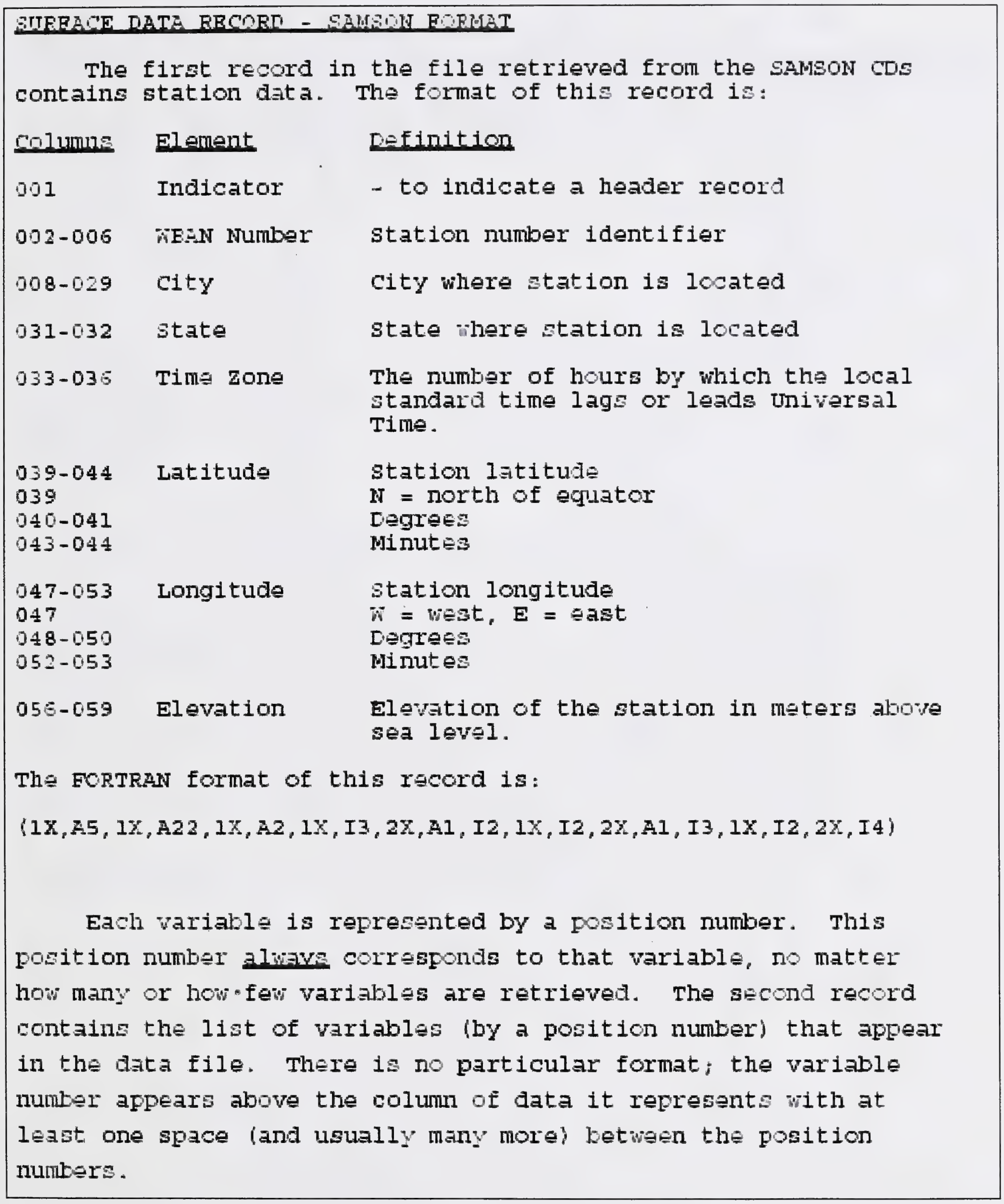
- All resultant wind speeds predicted by MM5 to be less than 1 m/s are rounded up by MMEU to equal 1 m/s as per standard EPA practices described in Section 9.3.4 of Appendix W of the US EPA's guidelines on the use air quality models for regulatory applications (US EPA Appendix W to 40 CFR Part 51 – Guideline on Air Quality Models, April 15, 1003).

- In order to run AERMET, the met pre-processor for AERMOD, a surface file in SAMSON format and an upper air file in NCDC TD6201 format need to be created. The details of those specific formats can be found in B and C, respectively.

- As part of the extraction process, the user must also provide output file names and paths for both the SAMSON and RAOBS output files.

SAMSON Format:

Source: Pcrammet User's Guide, USEPA, June 1999, EPA-454/B-96-001



SURFACE DATA RECORD - SAMSON FORMAT

The first record in the file retrieved from the SAMSON CDs contains station data. The format of this record is:

Columns	Element	Definition
001	Indicator	~ to indicate a header record
002-006	WBAN Number	Station number identifier
008-029	City	City where station is located
031-032	State	State where station is located
033-036	Time Zone	The number of hours by which the local standard time lags or leads Universal Time.
039-044	Latitude	Station latitude
039		N = north of equator
040-041		Degrees
043-044		Minutes
047-053	Longitude	Station longitude
047		W = west, E = east
048-050		Degrees
052-053		Minutes
056-059	Elevation	Elevation of the station in meters above sea level.

The FORTRAN format of this record is:

```
(1X,A5,1X,A22,1X,A2,1X,I3,2X,A1,I2,1X,I2,2X,A1,I3,1X,I2,2X,I4)
```

Each variable is represented by a position number. This position number always corresponds to that variable, no matter how many or how few variables are retrieved. The second record contains the list of variables (by a position number) that appear in the data file. There is no particular format; the variable number appears above the column of data it represents with at least one space (and usually many more) between the position numbers.

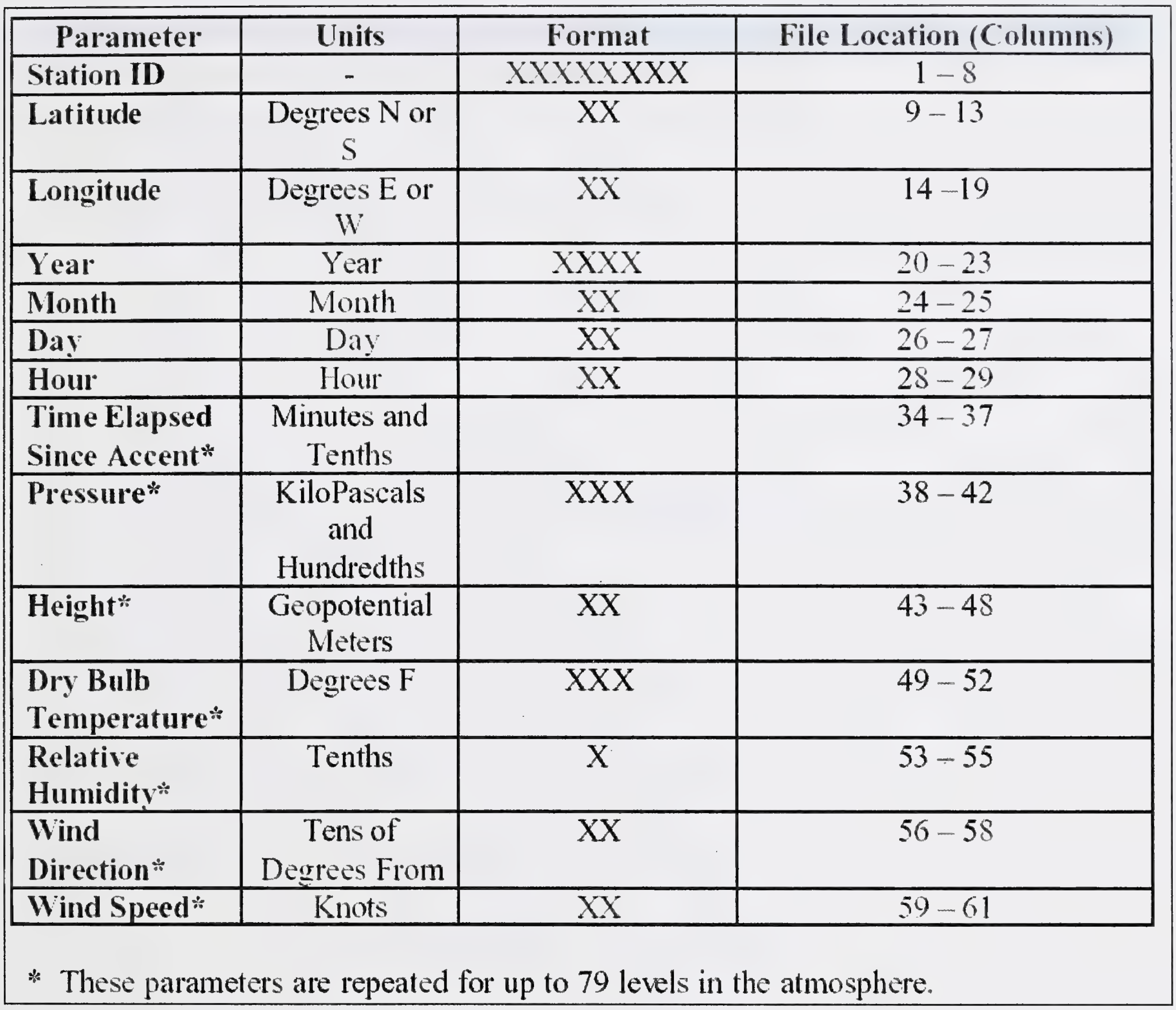
The third and subsequent records contain the weather elements retrieved from the SAMSON CDs. The data are free format, i.e., there is at least one space between each element in the record. The year, month, day, hour and observation indicator always appear on each record. These are followed by the variables retrieved by the user. If all the variables were retrieved, they would appear in the following order:

Position #	Description
	Year
	Month
	Day
	Hour (LST)
	Observation indicator
1	Extraterrestrial horizontal radiation
2	Extraterrestrial direct normal radiation
3	Global horizontal radiation
4	Direct normal radiation
5	Diffuse horizontal radiation
6	Total cloud cover
7	Opaque cloud cover
8	Dry bulb temperature
9	Dew point temperature
10	Relative humidity
11	Station pressure
12	Wind direction
13	Wind speed
14	Visibility
15	Ceiling height
16	Present weather
17	Precipitable water
18	Broadband aerosol optical depth
19	Snow depth
20	Days since last snowfall
21	Hourly precipitation amount and flag

The online help that accompanies the CDs contains a complete discussion of these variables, including the units, missing value indicators and any special considerations or comments.

RAOBS (NCDC TD6201) Format:

Source: Preparation of Alberta Environment Regional AERMOD Screening Meteorology Data Sets, Alberta Environment, March 2002.



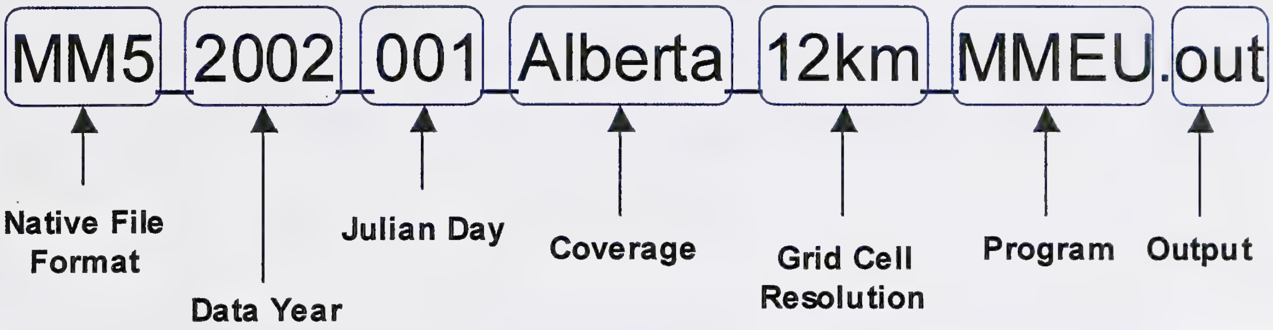
Parameter	Units	Format	File Location (Columns)
Station ID	-	XXXXXXXX	1 – 8
Latitude	Degrees N or S	XX	9 – 13
Longitude	Degrees E or W	XX	14 –19
Year	Year	XXXX	20 – 23
Month	Month	XX	24 – 25
Day	Day	XX	26 – 27
Hour	Hour	XX	28 – 29
Time Elapsed Since Accent*	Minutes and Tenths		34 – 37
Pressure*	KiloPascals and Hundredths	XXX	38 – 42
Height*	Geopotential Meters	XX	43 – 48
Dry Bulb Temperature*	Degrees F	XXX	49 – 52
Relative Humidity*	Tenths	X	53 – 55
Wind Direction*	Tens of Degrees From	XX	56 – 58
Wind Speed*	Knots	XX	59 – 61

* These parameters are repeated for up to 79 levels in the atmosphere.

APPENDIX H

APPENDIX H. ALBERTA SUBSET 12 KM RESOLUTION MM5 FILES PROVIDED TO ALBERTA ENVIRONMENT

ALBERTA SUBSET MM5 FILE NAMING CONVENTION:



Notes:

Daily MM5 files are approximately 225 Mb in size.

RWDI provided the MM5 files to Alberta Environment on an external, 350 Gb portable hard drive. Duplicate copies of the data were organized into two directory formats on that hard drive: one single directory containing all files; and, a DVD-ready directory structure to facilitate the creation of distributable DVDs with 19 days worth of MM5 files (4.17 Gb of data) per DVD, except DVD No. 20, which contains only 5 days of output (1.31 Gb of data). The DVD-ready directory structure is defined in the following tables.

DVD No.	**Files**
1	MM5_2002_001_Alberta_12km_MMEU.out
	MM5_2002_002_Alberta_12km_MMEU.out
	MM5_2002_003_Alberta_12km_MMEU.out
	MM5_2002_004_Alberta_12km_MMEU.out
	MM5_2002_005_Alberta_12km_MMEU.out
	MM5_2002_006_Alberta_12km_MMEU.out
	MM5_2002_007_Alberta_12km_MMEU.out
	MM5_2002_008_Alberta_12km_MMEU.out
	MM5_2002_009_Alberta_12km_MMEU.out
	MM5_2002_010_Alberta_12km_MMEU.out
	MM5_2002_011_Alberta_12km_MMEU.out
	MM5_2002_012_Alberta_12km_MMEU.out
	MM5_2002_013_Alberta_12km_MMEU.out
	MM5_2002_014_Alberta_12km_MMEU.out
	MM5_2002_015_Alberta_12km_MMEU.out
	MM5_2002_016_Alberta_12km_MMEU.out
	MM5_2002_017_Alberta_12km_MMEU.out
	MM5_2002_018_Alberta_12km_MMEU.out
	MM5_2002_019_Alberta_12km_MMEU.out

2	MM5_2002_020_Alberta_12km_MMEU.out … MM5_2002_038_Alberta_12km_MMEU.out
3	MM5_2002_039_Alberta_12km_MMEU.out … MM5_2002_057_Alberta_12km_MMEU.out
4	MM5_2002_058_Alberta_12km_MMEU.out … MM5_2002_076_Alberta_12km_MMEU.out
5	MM5_2002_077_Alberta_12km_MMEU.out … MM5_2002_095_Alberta_12km_MMEU.out
6	MM5_2002_096_Alberta_12km_MMEU.out … MM5_2002_114_Alberta_12km_MMEU.out
7	MM5_2002_115_Alberta_12km_MMEU.out … MM5_2002_133_Alberta_12km_MMEU.out
8	MM5_2002_134_Alberta_12km_MMEU.out … MM5_2002_152_Alberta_12km_MMEU.out
9	MM5_2002_153_Alberta_12km_MMEU.out … MM5_2002_171_Alberta_12km_MMEU.out
10	MM5_2002_172_Alberta_12km_MMEU.out … MM5_2002_190_Alberta_12km_MMEU.out
11	MM5_2002_191_Alberta_12km_MMEU.out … MM5_2002_209_Alberta_12km_MMEU.out
12	MM5_2002_210_Alberta_12km_MMEU.out … MM5_2002_228_Alberta_12km_MMEU.out

13	MM5_2002_229_Alberta_12km_MMEU.out … MM5_2002_247_Alberta_12km_MMEU.out
14	MM5_2002_248_Alberta_12km_MMEU.out … MM5_2002_266_Alberta_12km_MMEU.out
15	MM5_2002_267_Alberta_12km_MMEU.out … MM5_2002_285_Alberta_12km_MMEU.out
16	MM5_2002_286_Alberta_12km_MMEU.out … MM5_2002_304_Alberta_12km_MMEU.out
17	MM5_2002_305_Alberta_12km_MMEU.out … MM5_2002_323_Alberta_12km_MMEU.out
18	MM5_2002_324_Alberta_12km_MMEU.out … MM5_2002_342_Alberta_12km_MMEU.out
19	MM5_2002_343_Alberta_12km_MMEU.out … MM5_2002_361_Alberta_12km_MMEU.out
20	MM5_2002_362_Alberta_12km_MMEU.out MM5_2002_363_Alberta_12km_MMEU.out MM5_2002_364_Alberta_12km_MMEU.out MM5_2002_365_Alberta_12km_MMEU.out MM5_2003_001_Alberta_12km_MMEU.out

LIBRARY AND ARCHIVES CANADA
Bibliothèque et Archives Canada
3 3286 53529965 1